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IS 13429-1 (2000): Solar Cooker - Box Type, Part 1:
Requirements [MED 4: Non-Conventional Energy Sources]



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भाग 1 अपेक्षाएँ

(पहला पुनरीक्षण)

Indian Standard

SOLAR COOKER — BOX TYPE — SPECIFICATION

PART 1 REQUIREMENTS

(*First Revision*)

ICS 27.160, 97.040.20

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BUREAU OF INDIAN STANDARDS
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FOREWORD

This Indian Standard (Part 1) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Non-Conventional Energy Sources Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard was first published in 1992 as one of the three parts of Indian Standards on solar cooker, the other two parts being on Components and Test method. One amendment was issued in January 1993.

This standard has been revised based on the feedback received from various organizations connected with the solar cooking programme in the country. The present revision has been drafted with a view not to restrict the size, material, shape and design and simultaneously specifying the requisite performance parameters.

The other parts of solar cooker standards simultaneously revised are as follows:

IS 13429 (Part 2) Solar cooker — Box type — Specification: Part 2 Components (*first revision*)

IS 13429 (Part 3) Solar cooker — Box type — Specification: Part 3 Test method (*first revision*)

The solar cookers covered in this standard shall be of two grades A and B depending upon their thermal performance. The cookers with lower thermal performance value (F_1) designated as Grade B may be conveniently used in the regions like Gujarat, Madhya Pradesh, Maharashtra, etc, where solar intensity during the major part of the year is high. In Northern Region like Delhi, Haryana, Punjab, J&K, etc, where the solar intensity although in summer may be high but in winters the lower thermal performance (F_1) of cookers may not be adequate to cook the food due to poor solar intensity. For such reasons the use of cookers of higher thermal performance (F_1) designated as Grade A is recommended.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard. Where specific limit ('Maximum' or 'Minimum') has been stipulated in the standard the values obtained shall be rounded off in one direction only in accordance with Amendment No. 1 February 1997 to IS 2 : 1960 (*revised*).

*Indian Standard***SOLAR COOKER — BOX TYPE — SPECIFICATION****PART 1 REQUIREMENTS***(First Revision)***1 SCOPE**

1.1 This standard (Part 1) specifies the requirements of box type solar cookers for cooking.

1.2 The solar cookers covered in this standard shall be of two grades depending upon their thermal performance (F_1).

Grade A — F_1 shall not be less than 0.12

Grade B — F_1 shall not be less than 0.11

2 REFERENCES

The Indian Standards listed below contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
12934 : 1990	Solar energy — Thermal applications — Vocabulary
13429	Solar cooker — Box type — Specification:
(Part 2) : 2000	Components (<i>first revision</i>)
(Part 3) : 2000	Test method (<i>first revision</i>)

3 DEFINITIONS

For the purpose of this standard the terminology and definitions given in IS 12934 shall be applicable.

4 COMPONENTS

Components of box type solar cooker shall conform to the requirements specified in IS 13429 (Part 2).

5 SHAPE

Typical shape of box type solar cooker is given in Fig. 1.

NOTE — The box type solar cooker may be of any other shape and design.

6 ASSEMBLY OF COMPONENTS

The solar cooker shall be assembled so that replaceable components are easily accessible for repair or replacement. There shall be no direct contact between

cooking tray and cooker box. The top cover of the cooker box shall not cause any pressure either on the cover plate or on the mirror.

7 TESTS FOR SOLAR COOKER PERFORMANCE**7.1 Routine Tests****7.1.1 Leakage Test**

The cooker tray, rubber gaskets and cover plate shall be subjected to the leakage test in accordance with 4.1 of IS 13429 (Part 3). There shall be no sign of leakage.

7.1.2 Slam Test

The cooker shall be subjected to slam test in accordance with 4.2 of IS 13429 (Part 3). There shall be no damage to cover plate, mirror or any part of cooker.

7.1.3 Mirror Reflectivity Test

The mirror shall be subjected to reflectivity test in accordance with 4.3 of IS 13429 (Part 3). It shall have minimum 65 percent reflectivity.

7.2 Type Tests**7.2.1 Exposure Test**

The cooker shall be subjected to exposure test in accordance with 4.4 of IS 13429 (Part 3). There shall be no

- appearance of any sign of degradation of rubber or plastic material;
- outgassing from the insulation material;
- discoloration or peeling of black paint on the cooking pots and cooking tray;
- deposition of water vapour, dust or any other material inside the cover plate when inspected visually; and
- cracking of glazings and/or mirror and/or body of the cover.

7.2.2 Load Test

The cooker box made of fiber reinforced plastic shall be subjected to load test with 50 kg load kept on the box at the centre covering 50 percent of top surface area, for one hour. No cracks shall appear on the box when inspected visually with naked eye.

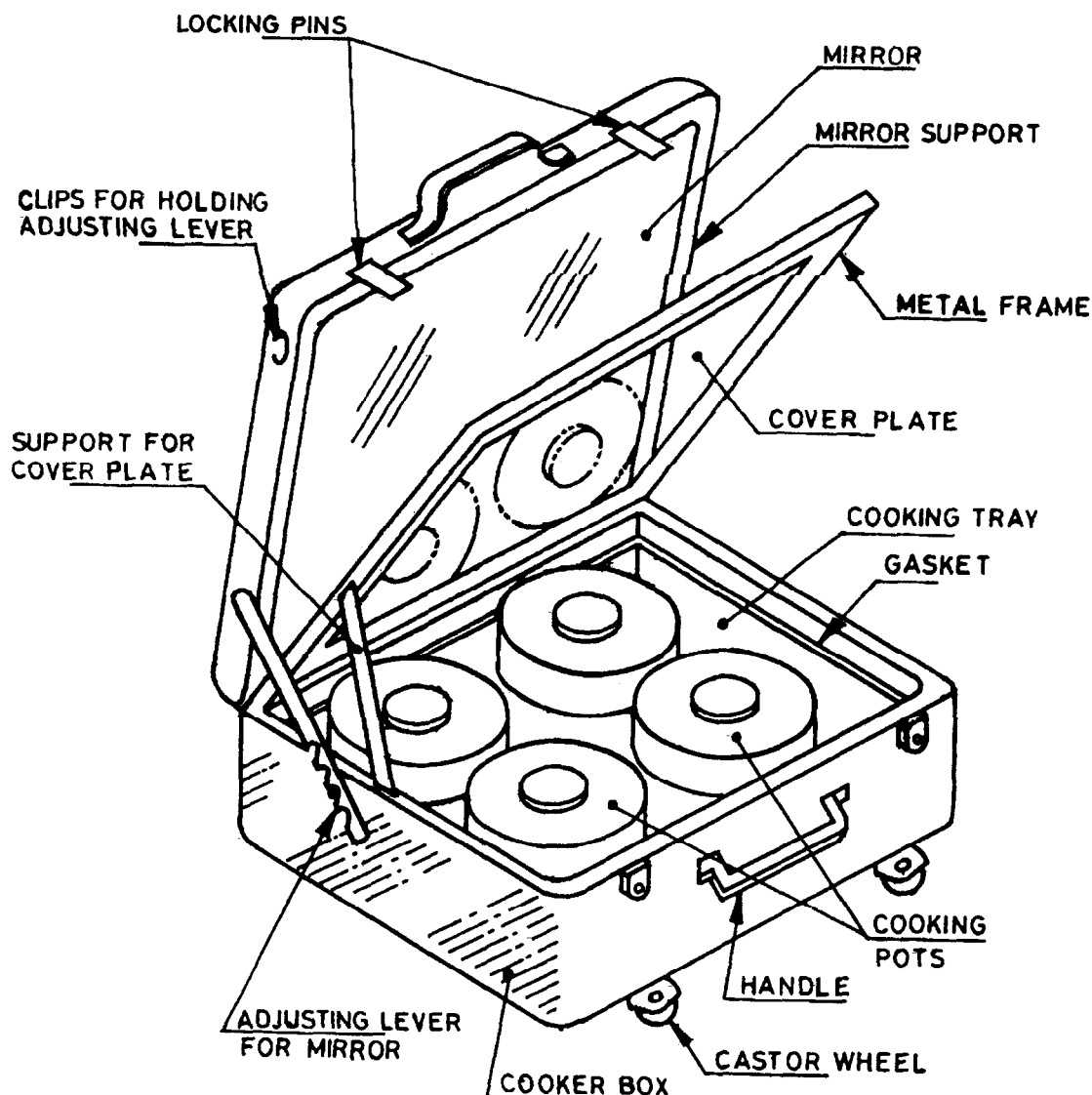


FIG. 1 SCHEMATIC OF A TYPICAL BOX TYPE SOLAR COOKER

7.2.3 Thermal Performance Test

The cooker shall be subjected to thermal performance test in accordance with 4.5 of IS 13429 (Part 3). The figure of merit F_1 shall be as mentioned below:

Grade A Cooker — F_1 shall not be less than 0.12

Grade B Cooker — F_1 shall not be less than 0.11

The figure of merit F_2 shall be greater than 0.40.

7.3 The test results of routine/type tests and of components covered in IS 13429 (Part 2) shall be reported by the independent laboratory in the proforma given in this standard.

8 INSTRUCTION MANUAL

The manufacturer shall provide the instruction manual consisting of the following information:

- How to use solar cooker;
- Advantages and limitations;
- General instructions for maintenance, trouble shootings and orientation of solar cooker;
- Estimated boiling time for a standard load under specified climatic conditions as mentioned in IS 13429 (Part 3) and provided by the test centre;
- Illustrative schematic diagram of the solar cooker;
- List of names and addresses of manufacturers and suppliers of spare parts of box type solar cookers and also of repair facilities in the region; and
- Information about the regions of the country where the cooker could be suitable for use.

NOTE — The cooker may also be supplied with the recipe book.

9 MARKING

9.1 The solar cooker shall be marked clearly and permanently with the following information:

- a) Manufacturer's name and either initials or recognized trade-name; if any,
- b) The serial number,
- c) The country of manufacture,
- d) Month and year of manufacture,
- e) Mass of solar cooker in kg,
- f) Grade of the cooker (*see 7.2.3*), and
- g) Type of vessels for cooking (Stainless Steel or Aluminium) and their total capacity in litres.

9.2 BIS Standard Mark

9.2.1 The solar cooker may also be marked with the Standard Mark.

9.2.2 The use of Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which a licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

10 PACKING

The solar cookers shall be packed as agreed to between the purchaser and the supplier. The grade of the cooker shall be clearly marked on the package.

PROFORMA**Test Report Format for Box Type Solar Cooker as per
IS 13429 (Parts 1, 2 and 3)****1 Name and Address of Manufacturer**

Telephone: _____

Fax: _____

e-mail _____

2 Specifications of Solar Cooker and Testing Results

(All dimensions are in mm, unless specified otherwise)

<i>Sl No.</i>	<i>Specifications/Tests</i>	<i>Specified Requirements</i>	<i>Results</i>
2.1	Cover Plate [4.1 of IS 13429 (Part 2)]		
2.1.1	Number of glazing	Two	
2.1.2	Material — Inner plate — Outer plate		Single piece glass Plain/ Toughened Plain/ Toughened
2.1.3	Spacing between outer and inner plate	10 ± 2	
2.1.4	Glass thickness, <i>Min</i> — Inner plate — Outer plate		
2.1.5	Solar transmittance of double glass lid at near normal incidence	65 percent, <i>Min</i>	
2.1.6	General appearance of glazing	Free from bubble/rough surface	
2.1.7	Aperture area		
2.1.8	Additional design feature	Provision for keeping cover plate in inclined position	
2.2	Cooking Tray [4.2 of IS 13429 (Part 2)]		
2.2.1	Size		
2.2.2	Material	Al/Cu	
2.2.3	Thickness, <i>Min</i>	0.5	
2.2.4	Paint on inner surface	Matt black finish	
2.2.5	Temperature test for paint at 175°C for 1h	No deterioration of finished surface	
2.2.6	Scratch test after dipping of the painted surface in boiling water for 10 min [4.2.2 of IS 13429 (Part 2)]	No peeling of paint	
2.3	Cooker Box [4.3 of IS 13429 (Part 2)]		
2.3.1	Material	May be GS/ Al/FRP	

Sl No.	Specifications/Tests	Specified Requirements	Results
2.3.2	Thickness, <i>Min</i>	0.45 / 0.5 / 1.0, respectively if the above materials are used.	
2.3.3	Size		
2.3.4	General finish	Smooth, even and free from sharp edges	
2.4	Gaskets and Sealant [4.4 of IS 13429 (Part 2)]		
2.4.1	Material	Neoprene/ EPDM/ Silicone rubber	
2.4.2	Thickness, <i>Min</i>	2	
2.4.3	Thermal shock test [5.2 of IS 13429 (Part 2)]	No crack or brittleness	
2.5	Insulation (A certificate regarding <i>K</i> -value and temperature test by the manufacturer shall be submitted) [4.5 of IS 13429 (Part 2)]		
2.5.1	Pad thickness a) Sides and edges b) Back		
2.5.2	<i>K</i> -value at 100°C (as per certificate)		
2.5.3	Thermal resistance value (<i>R</i>) as calculated by dividing thickness of insulation used by <i>K</i> -value	0.96 m ² °C/W <i>Min</i> and 0.58 m ² °C/W <i>Min</i> for metallic and non-metallic body solar cookers, respectively	
2.6	Reflecting Mirror [4.6 of IS 13429 (Part 2)]		
2.6.1	General appearance	Free from bubbles/ waviness	
2.6.2	Size		
2.6.3	Thickness, <i>Min</i>		
2.6.4	Solar reflectance [4.3 of IS 13429 (Part 3)]	65 percent, <i>Min</i>	
2.6.5	Additional design feature	Provision for keeping the mirror in inclined position	
2.7	Cooking Pots with Lid [4.7 of IS 13429 (Part 2)]		
2.7.1	Material	Al alloy/ SS	
2.7.2	Thickness		
2.7.3	Number		
2.7.4	Depth		
2.7.5	Diameter		
2.7.6	Total capacity of the pots in litres		
2.7.7	Coating on outside surface	Matt black finish	
2.7.8	Coating on bottom	No coating	
2.7.9	Temperature test for paint at 175°C for 1h	No deterioration of finished surface	

<i>Sl No.</i>	<i>Specifications/Tests</i>	<i>Specified Requirements</i>	<i>Results</i>
2.7.10	Scratch test after dipping of the painted surface in boiling water for 10 min [4.2.2 of IS 13429 (Part 2)]	No peeling of paint	
2.8	Caster Wheels (Optional) [4.8 of IS 13429 (Part 2)]		
2.8.1	Number	Four	
2.8.2	Construction	Having ball bearing. Alternatively, two cylindrical supports for front, and two wheels for rear, all made of plastic or non-corrosive material	
2.9	Workmanship and Finish of Components [4.9 of IS 13429 (Part 2)]		
		• All surfaces smooth and free from roughness, raised spots, scale or any other defects • Sharp edges and corners rounded off • Screws, hinges, lever rods, locks, handle, caster wheels, etc, properly fitted • Weight of components set in such a way that the cooker does not topple back when opened for its loading/unloading	
2.10	Assembly of Components [6 of IS 13429 (Part 1)]		
		• Replaceable components are easily accessible for repair/replacement • There is no direct contact between tray and cooker box • Top cover of the cooker box causes no pressure either on cover plate or on the mirror	
2.11	Routine Tests		
2.11.1	Cooking tray leakage test [4.1.1 of IS 13429 (Part 3)]	No sign of leakage	
2.11.2	Rubber gasket leakage test [4.1.2 of IS 13429 (Part 3)]	No sign of leakage	
2.11.3	Leakage test for upper side of cover plate [4.1.3(a) of IS 13429 (Part 3)]	No sign of leakage	
2.11.4	Leakage test for lower side of cover plate [4.1.3(a) of IS 13429 (Part 3)]	No sign of leakage	
2.11.5	Rain penetration test [4.1.4 of IS 13429 (Part 3)]	No sign of entry of water vapour	
2.11.6	Slam test [4.2 of IS 13429 (Part 3)]	No damage to cover plate, mirror or any part of cooker [7.1.2 of IS 13429 (Part 1)]	

Sl No.	Specifications/Tests	Specified Requirements	Results
2.11.7	Mirror reflectivity test [4.3 of IS 13429 (Part 3)]	65 percent, <i>Min</i> [7.1.3 of IS 13429 (Part 1)]	
2.12	Type Tests		
2.12.1	Exposure test [4.4 of IS 13429 (Part 3)]	• No appearance or any sign of degradation of rubber or plastic material • No outgassing from the insulation material • No discoloration or peeling off of the black paint on cooking pots and cooking tray • No deposition of water vapour, dust or any other material inside the cover plate when inspected visually • No cracking of glazing and/or mirror and/or body	
2.12.2	Load test for FRP body cookers only [7.2.2 of IS 13429 (Part 1)]	No appearance of any cracks on the box when inspected visually with naked eye	
2.12.3	Thermal performance test, <i>Min</i> [4.5 of IS 13429 (Part 3)]		
2.12.4	Stagnation temperature test	F_1 not less than 0.12 for Grade A solar cooker F_1 not less than 0.11 for Grade B solar cooker	
	Load test: Sensible heating of water	F_2 greater than 0.4	
	Standard boiling time	Enclose a graph showing the variation of t_{boil} in minutes with $X = [(100 - T_a)/G]$ as shown in Fig. 2.	
2.13	Marking and Packing Details		
		• Manufacturer's name/initials/recognized trade-name	
		• Serial number	
		• The country of manufacture	
		• Month & year of manufacture	
		• Mass of solar cooker	
		• Grade of solar cooker	
		• Type of vessels for cooking and their total capacity in litres	

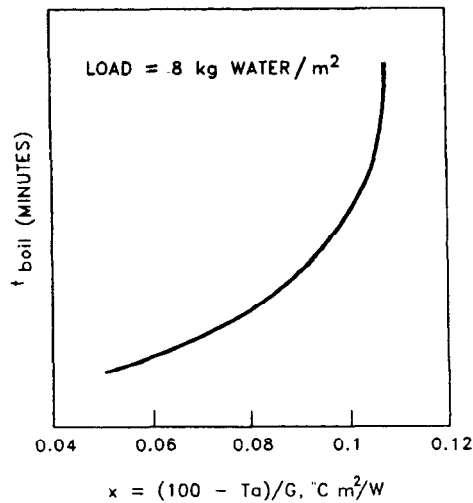


FIG. 2 GRAPH SHOWING THE VARIATION OF t_{boil} (IN MINUTES) WITH $[X = (100 - T_a)/G]$

3 Test Data

3.1 Curves showing the time variation of tray temperature, solar radiation intensity and ambient temperature during the no load test (with date) for all the three valid sets of readings used in deriving the value of F_1 shall be presented.

3.2 Curves showing the time variation of water temperature in the largest cooking pot, solar radiation intensity and ambient temperature for all the three valid sets of readings used in deriving the value of F_2 shall be presented.

3.3 The average value of wind speed during the measurements shall also be reported with each of the above set of test data.

4 Boiling Time (t_{boil})

Table 1 shall be deduced using the test values of F_1 and F_2 for the conditions of solar intensity and ambient temperature corresponding to a load of 8 kg of water per square metre aperture area of the solar cooker. It may be noted that the actual boiling time shall be less than the values indicated in Table 1 on account of the use of reflecting mirror in appropriate inclination/ orientation.

Table 1 Boiling Time as Deduced Using Test Values of F_1 and F_2 for the Test Cooker for Standard Conditions for a Load of 8 kg of Water/m² of Aperture Area
(SI No. 4)

Solar Intensity (W/m ²)	Ambient Temperature (°C)			
↓	10	20	30	40
400				
500				
600				
700				
800				
900				

5 Remarks

Date

Authorized Signatory

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Amendments Issued Since Publication

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